REMARKS

Grounds of Rejections

Claims 170, 174-177, 262, 263, 265-267 and 270 have been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Kinsman et al. (US Patent No. 6,717,245) and Farnworth et al. (US Patent No. 6,620,731).

Claims 171 and 268 have been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Kinsman et al. (US Patent No. 6,717,245), Farnworth et al. (US Patent No. 6,620,731) and Beffa et al. (US Patent No. 6,233,185).

Claims 172, 173, 264 and 265 have been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Kinsman et al. (US Patent No. 6,717,245), Farnworth et al. (US Patent No. 6,620,731) and Farnworth et al. (US Patent No. 6,097,087).

Claim 178 has been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Kinsman et al. (US Patent No. 6,717,245), Farnworth et al. (US Patent No. 6,620,731) and Akram (US Patent No. 6,544,821).

Claim 179 has been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Kinsman et al. (US Patent No. 6,717,245), Farnworth et al. (US Patent No. 6,620,731) and Gilleo et al. (US Patent No. 6,228,678).

Claim 269 has been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Kinsman et al. (US Patent No. 6,717,245), Farnworth et al. (US Patent No. 6,620,731) and Lin (US Patent No. 5,436,203).

Claim 271 has been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Kinsman et al. (US Patent No. 6,717,245), Farnworth et al. (US Patent No. 6,620,731) and "Functional Smart Materials" by Wang.

The rejections under 35 USC §103 are traversed for the reasons to follow.

Summary Of Claimed Subject Matter

Claims 170-179 and 262-271 are directed to a semiconductor component 16 (Figures 4A-4C and 1K) which includes a thinned semiconductor die 10T (Figure 4C) having a circuit side 20 (Figure 4C), a thinned back side 22T (Figure 4C), and a plurality of peripheral edges 30 (Figure 4C). The component 16 (Figures 4A-4C) also includes a first polymer layer (circuit side polymer layer 36P (Figure 4C) and edge polymer layers 40 (Figure 4C) covering the circuit side 20 and the edges 30. The component 16 (Figures 4A-4C) also includes a second polymer layer (back side polymer layer 38P (Figure 4C)) covering the back side 22T.

The component 16 (Figures 4A-4C) also includes a plurality of die contacts 18 (Figure 4C) on the die 10T, and a plurality of contact bumps 24P (Figure 4B) on the die contacts 18 embedded in the first polymer layer 36P (Figure 4C). The component 16 (Figures 4A-4C) can also include terminal contacts 42 (Figure 4C) on the contact bumps 24P. As shown in Figure 8F, the component can also include conductive vias 70A (Figure 8F) in electrical communication with the die contacts 18, and terminal contacts 42A (Figure 8F) on the conductive vias 70A.

35 USC §103(a) Rejections Of Claims 170, 174-177, 262, 263, 265-267 and 270 Over Wakabayashi, Kinsman et al. and Farnworth et al. ('731)

Wakabayashi was cited as disclosing a semiconductor component comprising a semiconductor die (1-Figure 10), a plurality of contact bumps (electrodes 6-Figure 10), a first polymer layer (seal film 13-Figure 15) covering the circuit side and edges of the die, and a second polymer layer (seal film 17-Figure 15) covering the back side of the die.

Kinsman et al. was cited as disclosing a component having contact bumps (conductive elements 20) and terminal contacts (external conductive elements 32) on the contacts bumps.

Farnworth et al. ('731) was cited as disclosing a component having a thinned die (column 8, lines 61-67) with conductive vias (conductive member 34).

The rejected claims have been amended to include additional recitations which further distinguish the claimed component from the prior art. Independent claim 170 has been amended to recite "a first polymer layer comprising a self planarizing thermoset underfill film". Antecedent basis for this recitation is contained on page 32, line 28 to page 33, line 7 of the specification (paragraphs [0175] and [0176] of the published application). In addition, the first polymer layer in the form of a self planarizing thermoset underfill film 40UF is shown in Figure 1R. Further, an "underfill" feature was previously recited in dependent claim 179 but without the "self planarizing thermoset"

limitations. As claim 179 is contained in the elected embodiment (Embodiment II), the amendments to claim 170 are consistent with the previous species election.

Dependent claim 179 which recited the "underfill" feature has been rejected over Gilleo et al. Although underfill films are known in the art, they have not heretofore been used to encapsulate, support and rigidify the edges of a thinned die. In this regard, underfill materials are typically utilized to fill the space between a flip chip component and a substrate such as printed circuit board. For example, in Gilleo et al. the circuit side of a wafer 12 is covered with an underfill material 14 having "properties suitable for use as a flip chip underfill" (column 4, lines 21-22).

However, there is no disclosure or suggestion in the art of using an underfill film to encapsulate a thinned die. In the present component the underfill film provides new and unexpected results in that the first polymer layer 40 (Figure 1K) has a planar surface, but a planarizing step is not required (page 33, lines 5-7, paragraph [0176] of the specification). The new and unexpected results are one indicia of unobviousness.

Amended claim 170 also recites "the first polymer layer and the second polymer layer encapsulating the die on six sides and supporting the die, the contact bumps and the peripheral edges." Antecedent basis for the "supporting" recitation is contained on page 29, lines 4-6, paragraph [0161] of the specification. Although underfill layers have been used to support terminal contacts, they have not heretofore been used to perform the dual function of supporting contact bumps, and the thinned edges of a thinned die as well. Additionally, although thinned dice are known in the art, they have not heretofore been supported by an underfill film. Again the underfill film provides new and unexpected results, as it does not require a planarization step. Such a planarization step can be damaging to the die, particularly in combination with a die thinning step.

Each of the rejected dependent claims (174-177, 262, 263, 265-267 and 270) is submitted to be unobvious for the same reasons as independent claim 170. Specifically, a component having a thinned die encapsulated and supported by a self planarizing underfill film is submitted to be unobvious over the art. In addition, the dependent claims have been amended to include recitations which further distinguish the claimed component from the prior art.

Dependent claim 174 has been amended to recite the "first polymer layer and the second polymer layer have beveled edges." Antecedent basis for this recitation is contained on page 32, lines 17-19, paragraph [0173]. In addition, the beveled edges 51 are shown in Figure 1O. One advantage of this construction is that stresses on the edges of the component are reduced. As the prior art does not disclose a beveled underfill film

used to encapsulate and rigidify a thinned die, claim 174 is submitted to be unobvious over the art.

Dependent claim 175 has been amended to recite "a plurality of terminal contacts on the contact bumps." The terminal contacts 42 are shown in Figure 1K. Although, Kinsman et al. discloses terminal contacts on contact bumps, it does not suggest embedding the contact bumps in a self planarizing underfill material. Rather, Kinsman et al. teaches an encapsulant 30 which requires planarization by CMP (column 6, line 23).

Dependent claim 176 has been amended to recite "the first polymer layer has a thickness which is less than a height of the contact bumps and each contact bump is surrounded by a portion of the first polymer layer". Antecedent basis for this recitation is contained on page 33, lines 25-28, paragraph [0178] of the specification. This feature also provides new and unexpected results as the contact bumps can be used as terminal contacts (page 34, line 22, paragraph [0181]).

Dependent claim 177 has been amended to recite "the die includes conductive vias in electrical communication with the die contacts and the contact bumps." Although conductive vias are known in the art, a component with conductive vias on a thinned die encapsulated by an self planarizing underfill film, is submitted to be unobvious over the art.

Dependent claim 262 has been amended to recite "the die contacts comprise a solderable metal, and the contact bumps comprise solder." Antecedent basis for this recitation is contained on page 17, line 14 [paragraph 0119], and on page 17, line 34 paragraph [0121] of the specification. One advantage of these materials is that the contact bumps can also be used as terminal contacts. Claim 262 is submitted to be unobvious in combination with claim 170.

Dependent claim 263 has been amended to recite "a plurality of terminal contacts on the die in electrical communication with the contact bumps in a standardized grid array." Antecedent basis for this recitation is contained on page 27, line 3, paragraph [0153] of the specification. Claim 263 is submitted to be unobvious in combination with claim 170.

Dependent claims 265-267 have not been amended, but are submitted to be unobvious in combination with claim 170.

Dependent claim 270 has been amended to recite "the second polymer layer comprises the underfill film, and the underfill film cures and planarizes at a temperature of about 200-250 °C, has a Young's modulus of about 4G Pascal, and a coefficient of thermal expansion (CTE) of about 33 parts per million per °C." Antecedent basis for this recitation is contained on page 34, lines 6-9, paragraph [0180], and on page 32, line 28 to

page 33, line 2, paragraph [0175] of the specification. Although underfill materials having the stated properties are known in the art, they have not heretofore been used to encapsulate a thinned die on six sides. Accordingly claim 270 is submitted to be unobvious over the art. Further, claim 270 is submitted to be unobvious in combination with claim 170.

35 USC §103(a) Rejections Of Claims 171 and 268 Over Wakabayashi, Kinsman et al., Farnworth et al. and Beffa et al.

Dependent claims 171 and 268 recite that the thinned die comprises a "tested and burned in die". Beffa et al. was cited as disclosing the feature of tested and burned in dice. Although tested dice are known in the art, the presently claimed component having a "thinned die", which is also "tested and burned in" is submitted to be novel and unobvious over the art. In addition, claims 171 and 268 are submitted to be unobvious in combination with claim 170.

35 USC §103(a) Rejections Of Claims 172, 173, 264 and 265 Over Wakabayashi, Kinsman et al., Farnworth et al. and Farnworth et al.

Dependent claim 172 has been amended to recite "the underfill film cures and planarizes at a temperature of about 200-250 °C, has a Young's modulus of about 4G Pascal, and a coefficient of thermal expansion (CTE) of about 33 parts per million per °C." Antecedent basis for this recitation is contained on page 32, line 28 to page 33, line 2, paragraph [0175] of the specification. Although underfill materials having the stated properties are known in the art, they have not heretofore been used to encapsulate and rigidify the edges of a thinned die. Accordingly claim 172 is submitted to be unobvious over the art. Further, claim 172 is submitted to be unobvious in combination with claim 170.

Dependent claim 173 has been amended to recite "the second polymer layer comprises the underfill film." Antecedent basis for this recitation is contained on page 34, lines 6-9, paragraph [0180]. Although underfill layers are known in the art, they have not heretofore been used to encapsulate a thinned die on six sides. Accordingly claim 173 is submitted to be unobvious over the art. Further, claim 173 is submitted to be unobvious in combination with claim 170.

Dependent claim 264 has been amended to recite "a plurality of terminal contacts comprising ball bonds on the contact bumps." Antecedent basis for this recitation is contained on page 26, line 24 [paragraph 0151] of the specification. Claim 264 is submitted to be unobvious in combination with claim 170.

Dependent claim 265 is submitted to be unobvious in combination with claim 170.

35 USC §103(a) Rejection Of Claim 178 Over Wakabayashi, Kinsman et al., Farnworth et al. and Akram

Dependent claim 178 has been amended to recite "the die contacts comprise bond pads." Antecedent basis for this recitation is contained on page 17, line 24-25, paragraph [0120] of the specification. Claim 178 is submitted to be unobvious in combination with claim 170.

35 USC §103(a) Rejection Of Claim 179 Over Wakabayashi, Kinsman et al., Farnworth et al. and Gilleo et al.

Dependent claim 179 has been amended to recite "the die contacts comprise redistribution pads." Antecedent basis for this recitation is contained on page 17, line 20, paragraph [0120] of the specification. Claim 179 is submitted to be unobvious in combination with claim 170.

35 USC §103(a) Rejection Of Claim 269 Over Wakabayashi, Kinsman et al., Farnworth et al. and Functional And Lin

Dependent claim 269 recites the feature of the thinned die being "on a semiconductor wafer" having "a polymer support dam". Claim 269 is submitted to be unobvious for the reasons stated in the Amendment dated September 11, 2006. Specifically, Lin does not teach or suggest a polymer support dam on a semiconductor wafer.

Further, this feature provides new and unexpected results in that damage to the thinned die during thinning is reduced by the polymer support dam. Still further, claim 269 is submitted to be unobvious in combination with claim 170.

35 USC §103(a) Rejection Of Claim 271 Over Wakabayashi, Kinsman et al., Farnworth et al. and Functional And Smart Materials

Dependent claim 271 has been amended to recite "the second polymer layer comprises parylene". Antecedent basis for this recitation is contained on page 25, lines 5-7, paragraph [0146] and on page 23, line 25, paragraph [0141]. Although parylene has been used in the art, it has not heretofore been used in combination with an underfill material to encapsulate a thinned die on six sides. Accordingly claim 271 is submitted to

unobvious over the art. Further, claim 271 is submitted to be unobvious in combination with claim 170.

Conclusion

In addition to the amendments to the claims, the "Cross Reference To Related Applications" has been updated, and an informality has been corrected on page 52.

In view of the amendments and arguments, favorable consideration and allowance of claims 170-179 and 262-271 is respectfully requested. An Information Disclosure Statement is being filed concurrently with this Amendment. Should any issues arise that will advance this case to allowance, the Examiner is asked to contact the undersigned by telephone.

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Respectfully submitted:

Stephen A. Gratton
Registration No. 28,418
Attorney for Applicant

2764 S. Braun Way
Lakewood, CO 80228
Telephone: (303) 989-6353
FAX (303) 989-6538

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Stephen A. Gratton, Attorney for Applicant